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OF

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FOR

FACILITY MODELIZATION FOR FACILITY BENCHMARKING

TITLE: FACILITY MODELIZATION FOR FACILITY

BENCHMARKING

BACKGROUND OF THE INVENTION

The present invention relates generally to improved method and apparatus for looking at energy use strategically. More specifically, the present invention relates to dynamic facility models that

5   highlight opportunities to reduce resource consumption while allowing a facility manager to cost-effectively meet facility resource requirements, by facility modelization for facility benchmarking.

Facility managers often face a daunting task in

10   their efforts to reduce costs associated with the consumption of electricity, gas and water (i.e., resources generally). Consider as an example the infrastructure of a typical major airport. The facility manager must cost-effectively provide the

15   utility needs for an infrastructure consisting of main runways, aircraft taxiing and parking areas, main airport buildings, passenger transport systems, and buildings housing franchised companies spread over several miles of land. Similarly, the facility

20   managers for public school systems, with monumental infrastructure needs, struggle to deliver the best educational environment for the fewest dollars. In certain more heavily competitive private markets, facility managers for giant retail stores, such as

25   Wal-Mart, must cost-effectively supply the resource needs for stores located in diverse areas of the country.

Cost-effectively meeting the resource demands of diverse facilities is a complicated task. Different

facilities, while having similar attributes, will
often have different resource utilization patterns.
In fact, the resource utilization patterns for a
particular facility may vary over time due to changes

5   in the facility attributes. Consequently, to
accurately model a facility and to then accurately
benchmark facility resource consumption, a dynamic
modeling process is required (i.e., a process that not
only considers facility attributes, but changes in

10   facility attributes over time).

Conventional practices, while using the well-
known concept of data normalization, does not
typically have the ability to track changes in
facility attributes over time. When a process does

15   not have the ability to track changes in facility
attributes, any such facility model will tend to be or
to become inaccurate and any data generated using such
a model would likewise be inaccurate.

For example, if one wishes to know the amount of

20   electrical power a facility uses per employee, for the
period of one year, one must determine the total power
used and the number of people employed, at all times
during the year in question in order to generate
accurate data. Using conventional methodology, one

25   could obtain the power utilization data from the power
utility. However, unless the number of employees
remained constant during the year in question, one
would be forced to estimate the number of employees
employed during the subject year. Finally, to obtain

30   normalized data, such a conventional process would
divide the power utilization data by the estimated
number of employees. While such information might be
useful to a limited extent, as noted, it would not be
completely accurate.

Likewise, changing the number of personal computers, copiers, vending machines, employees or the number of offices (among many other potential changes) all can significantly affect the electrical load on a facility. Therefore, such conventional modeling methodology would generate inaccurate data if the attributes of interest were the number of computers, number of offices, or any other attribute that changed during the time period of interest.

SUMMARY OF THE INVENTION

The present invention recognizes and addresses various of the foregoing limitations and drawbacks, and others, of such conventional practices. In such context, the present invention recognizes that having complete information concerning resource consumption is desirable to a facility manager wishing to monitor and control/reduce such resource consumption.

Thus, broadly speaking, one principal object of the present invention is to provide improved method and apparatus for facility modelization. Another broad object is to provide such improved facility modelization in the context of improved facility benchmarking capabilities. In such context, a general object is to provide improved method and apparatus for looking at resource consumption strategically by creating dynamic facility models that highlight opportunities to reduce resource consumption while allowing facility managers to cost-effectively meet facility resource requirements.

Another general object of the present invention is to provide, for customers with multiple facilities, improved method and apparatus for comparing and benchmarking such respective facilities based on resource consumption.

Still another object of the present invention is to provide improved method and apparatus for comparing and benchmarking multiple facilities, owned by different customers, based on resource consumption.

Another present object is to present facility resource utilization data and benchmarking data in the form of historical and/or real-time reports that highlight opportunities to reduce resource consumption and maximize resource consumption efficiency.

Yet another object of the present invention is to provide to all customers a methodology and apparatus resulting in centralized access to all facility models and resource consumption data.

Additional objects and advantages of the present invention are set forth in, or will be apparent to those skilled in the art from, the detailed description herein. Also, it should be further appreciated that modifications and variations to the specifically illustrated, referenced, and discussed steps or features hereof may be practiced in various uses and embodiments of this invention without departing from the spirit and scope thereof, by virtue of present reference thereto. Such variations may include, but are not limited to, substitution of equivalent steps or features for those shown, referenced or discussed, and the functional, operational, or positional reversal of various features, steps, parts, or the like. Still further, it is to be understood that different embodiments, as well as different presently preferred embodiments, of this invention may include various combinations or configurations of presently disclosed steps, features or elements, or their equivalents (including combinations of steps, features or parts or

configurations thereof not expressly shown in the figures or stated in the detailed description).

One exemplary such embodiment of the present invention relates to a method for modeling of facility performance. Such method may comprise the steps of assigning a predefined template to a facility to be modeled, obtaining resource utilization data for such facility, and normalizing such resource utilization data.

More preferably, a facility editor is used to assign predefined templates to a facility, which templates contain a list of facility attributes. The templates may include default facility attribute data. Likewise, the attributes are selected from an attribute catalog containing a list of user-defined and system-defined attributes. Importantly, as a facility changes over time, such facility templates and the attribute catalog may be updated to reflect such changes, thereby in such respect creating dynamic facility models.

The present invention is further functional in certain embodiments for determining the combined normalized resource utilization data for two or more facilities or groups of facilities. In certain such embodiments, the present invention may retrieve such facility resource utilization data and facility attribute data for two or more facilities and use an aggregation process or function to determine the total sum of such data. For example, assume that data for three facilities are retrieved, where the resource utilization data of interest is kWh, and the facility attribute data of interest is the number of employees. Such an exemplary aggregation process will return the total electricity consumption and the total number of

employees for all three facilities. Next, the
normalization process will generate normalized
resource utilization data using such aggregate values.

Using such aggregation and normalization
methodology, exemplary embodiments of the present
invention have the ability to perform numerous
comparisons based on facility resource utilization.
Such comparisons include, but are not limited to,
comparing normalized data for all facilities owned by
an entity, all similar facilities owned by an entity,
a user defined group of facilities owned by an entity,
one facility compared to the aggregated data for a
group of facilities, the aggregated data for facility
group 1 compared to aggregated data for facility group
2, or for any combination of facilities, or group of
facilities, regardless of ownership. In addition,
such comparisons may be used to benchmark facilities
based on normalized data.

In further exemplary embodiments of the present
invention, upon generating either normalized data or
benchmarking results, the present invention may
generate historical and/or real-time reports
presenting the facility modeling process or data
derived therefrom in a user-defined format. Such data
normalization, data aggregation, and report generation
steps in exemplary embodiments may be activated by the
occurrence of selected of the following events: user
update of facility attribute data, user demanded
report generation, or after a predefined period of
time elapses. Such exemplary resource utilization
data may represent such as energy, water, natural gas,
or oil consumption. In certain preferred embodiments,
the resource utilization data, the facility modeling
process, and the reports (all types) would be

maintained at a centralized location, such as on a
utility provider's mainframe computer system, and made
available to customers such as via the Internet or
some other interconnected (either wired and/or

5   wireless) electronic medium.

Another present exemplary embodiment of the
present invention concerns a method for facility
modeling and benchmarking. Such a method may include
the steps of creating an attribute catalog, assigning

10 attributes to a template, assigning selected of such
templates to a facility, obtaining resource
utilization data associated therewith, and normalizing
such resource utilization data.

More preferably, the attributes catalog may

15 comprise selected of user-defined and system-defended
attributes. A template editor ideally assigns
attributes to a new or pre-existing template selected
of user-defined or system-defined templates.
₊Similarly, a facility editor may assign templates

20 (selected of user-defined or system-defined templates)
to a facility. Furthermore, a benchmarking process
may compare normalized resource utilization data for
two or more facilities and may rank (i.e., benchmark)
such facilities based on resource consumption.

25 Yet another exemplary embodiment of the present
invention involves a method for creating dynamic
facility models, in relation to resource utilization
of such facilities, comparing resource utilization
efficiency of such facilities, and generating reports

30 in a user defined format that includes various
combinations of the foregoing steps, further including
the step of presenting such data in the form of
historical and/or real-time reports. In certain such
embodiments, the exemplary methodology may further

include making such resource utilization data and reports available to a customer via the Internet or some other interconnected (wired and/or wireless) electronic medium.

5   In another exemplary embodiment, the present invention provides an improved apparatus for creating dynamic facility models in relation to resource utilization of such facilities. A facility editor is used to assign predefined templates to a facility. A

10   data retrieval means is provided for obtaining resource utilization data for such facility while a data normalization means is provided for normalizing such resource utilization data, based on the predefined facility template. In certain of such

15   preferred embodiments, the predefined template may include default facility attribute data.

         Facility templates in certain embodiments may contain a list of facility attributes selected from a list of attributes contained in an attribute catalog.

20   To make facility models dynamic, a means may be provided for creating new facility attributes, adding new facility attributes to an attributes catalog, and/or deleting facility attributes from the attributes catalog. Such data retrieval means may be

25   further functional for obtaining resource utilization data as well as facility attribute data for two or more facilities.

         In accordance with the present invention, a single facility may be benchmarked based on resource

30   utilization without requiring a data aggregation process. When benchmarking two or more facilities based on resource utilization in accordance with exemplary embodiments of the present invention, aggregation of all resource utilization data and all

facility attribute data, for the facilities being benchmarked, is utilized. Thus, the present invention provides in certain instances both normalization and aggregation means. Once aggregation, normalization,

5 and/or benchmarking tasks are complete, a reporting means may be provided for generating historical and/or real-time reports. Finally, an electronic media means, such as the internet, or other interconnecting (wired and/or wireless) electronic media, may be

10 preferably practiced to supply customer access to selected of: facility modeling means, resource utilization data retrieval means, normalization means, normalized data benchmarking means, and a historical and/or real-time reports means.

15 Additional embodiments of the subject invention, not necessarily expressed in this summarized section, may include and incorporate various combinations of aspects of features or parts referenced in the summarized objectives above, and/or other features or

20 parts as otherwise discussed in this application. It should also be understood that the present invention equally pertains to apparatuses and devices corresponding with the exemplary metholodogies referenced, and vice versa.

25 Those of ordinary skill in the art will better appreciate the features and aspects of such embodiments, and others, upon review of the remainder of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

30 A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of the ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

Figure 1 depicts an exemplary display for a facility attribute catalog editor in accordance with a present exemplary embodiment;

Figure 2 depicts an exemplary display for a facility template editor screen in accordance with a present exemplary embodiment;

Figure 3 depicts an exemplary display for a facility Instances (i.e., defined points in time) management screen in accordance with a present exemplary embodiment;

Figure 4 depicts an exemplary facility model architecture sample in accordance with a present exemplary embodiment;

Figure 5 an exemplary list of sample so-called Instances for an aggregated facility; and

Figure 6 diagrammatically depicts an exemplary embodiment of a sample organization with which certain embodiments of the present invention may be operative.

Repeat use of reference characters throughout the present specification and appended drawings is intended to represent same or analogous features, elements or steps of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference now will be made in detail to embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features or steps illustrated or described as part of one embodiment can be used on or with another embodiment to yield a still

further embodiment. Thus, it is intended that the
present invention cover such modifications and
variations as come within the scope of the appended
claims and their equivalents. Other objects,
5   features, and aspects of the present invention are
disclosed in or may be determined from the following
detailed description, which is not intended as
limiting the broader aspects of the present invention.

A principal object of the present invention is to
10 provide a utility customer with a method for looking
at energy use strategically by creating dynamic
facility models. One full featured exemplary
embodiment of the present invention may include (1)
"Attribute Catalog", (2) "Template Editor", (3)
15 "Facility Editor", (4) "Normalization Process", (5)
"Aggregation Process" and (5) "Benchmarking Process."
Reference will now be made in detail to the above
components which in accordance with the subject
invention may be practiced in various combinations,
20 configurations and constructions as different
embodiments of such invention. While the particulars
of the present invention may be fully and readily
adapted by those of ordinary skill in the art for use
in modeling and benchmarking a facility using gas,
25 water, oil, etc., the examples discussed herein simply
are in the context of electrical power consumption.

An exemplary attribute catalog editor 10, shown
in Figure 1, allows a user such as a system
administrator to manage a list of facility attributes.
30 An exemplary facility catalog editor displays a
Facility ID 12, an attribute Name 14 (such as "Floor
Area"), an attribute Unit 16 (such as square feet),
and an attribute default value 18. Facility
attributes may be modified 20, added 24, or deleted 26

as desired, in accordance with the present invention.
If the user decides to make no modifications, the
operation may be canceled 22 and no changes will be
made.

5   The attribute catalog also displays the number of
attributes 30 associated with the subject facility ID.
The user can scroll through the attribute list for a
particular facility ID by using a slide-bar or arrow
menu feature 28. If a user wishes to change the units
10   for a particular attribute, the units may be typed
directly into window 16 or selected from a list of
units using dropdown arrow 17. The user presses the
"Apply" button 20 to add the selected attribute to a
list of attributes for the facility referenced by the
15   facility ID shown in window 12 and the attributes
counter 30 is automatically incremented.

"Button" as used herein includes virtually or
computer-generated images of buttons or similar, onto
which the user "clicks" or otherwise indicates
20   actuation thereof. They may also be regarded as
specialized function keys, provided in accordance with
the subject invention.

While transparent to the user, the attribute
catalog has two different types of attributes: (1)
25   "System-Defined" attributes, and (2) "User Defined"
attributes. For example, a large retailer (e.g., a
Wal-Mart store) may have an attribute not listed among
the "System-Defined" attributes. Therefore, a system
administrator for such Wal-Mart store(s) could in
30   accordance with the present invention create a "New"
attribute 24 (Figure 1) and add it to the Wal-Mart
attribute catalog. Such new entry constitutes a
"User-Defined" entry. In such example, only Wal-Mart
stores would have access to such new "User-Defined"

attribute whereas the "System-Defined" attributes are global to the entire system and can be accessed and utilized by all users.

Please note that the list of "System-Defined" attributes are preferably as extensive and complete as possible for a given context. When users model facilities using "System-Defined" attributes, the probability that different facilities will be modeled using identical facility attributes greatly increases. This, in turn, will maximize the benefits derived from using the benchmarking process (described in greater detail below). Consequently, a system level process, not accessible to a user, is operative for reclassifying a "User-Defined" attribute as a "System-Defined" attribute whenever a predetermined percentage of users have added such "User-Defined" attribute to the attributes catalog. Such predetermined percentage may be varied in accordance with the present invention.

Once the user has defined all attributes necessary to model a particular facility, the user then, in accordance with certain preferred embodiments of the subject invention, preferably interacts with an exemplary facility template editor 32, shown in Figure 2, to setup a new facility template or to edit an already existing facility template. For example, the user would create a new template by actuating "New" button 52 and giving such new template a name. Next the user selects, from the list of attributes displayed in an exemplary "window" 36, all the attributes that are to be assigned to such template. A separate window 42 may preferably list all attributes associated with the template identified by the name shown in a template selection window 34. The

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attribute catalog window 36 preferably lists all
attribute that have not been assigned to the selected
template. Attributes may be moved back and forth
between attribute catalog window 36 and template

5   window 42 using "buttons" or virtual function keys 38
and 40.

Should a user wish to edit or delete a template,
such user in accordance with the subject invention
would select the template of interest so that the

10   template's name appears in the template selection
window 34. Pressing down-arrow button 35 activates a
drop-down menu to assist in selecting the desired
template. Once such template has been selected, to
edit the template, the user would actuate an edit

15   button 50. After all changes are made, the user
simply presses an "Apply" button 44 to confirm the
changes or a "Cancel" button 46 to abandon the changes
and return the original values. To delete the
template, the user actuates the "Delete" button 48.

20   Please note that while facility attribute values
may remain constant for a period of time (or an
instant in time), facility attribute values have been
found to rarely be constant for all time.
Consequently, certain facility attribute values will

25   change over time and such changes must be accounted
for in the modeling process to yield accurate data.

In accordance with the present invention, an
exemplary facility editor 56, Figure 3, may be used to
define points in time (referenced herein as Instances)

30   where new attribute values are entered into the
system. When the user updates facility attribute
values, thereby refining a facility model, such event
marks the end of Instance X and the beginning of an
Instance X+1. The facility model accuracy increases

as time passes and as the number of Instances
increases, which in turn, results in data that is
increasingly representative of the real world.

5   To refine a facility model, the user selects the
appropriate month 58, year 62, and day 65 representing
the date of the change. A month is selected using
drop-down arrow 60, a year is selected using drop-down
arrow 64, and a day is selected by pressing the
appropriate day button 65. Next, the template name
10   that contains the attribute(s) to be changed should
appear in template name window 82. This template can
be chosen using the drop-down menu accessed by down-
arrow 84. The instance that contains the attribute
value(s) to be changed must now be selected using the
15   Instance navigator keys 94.

It should be noted that the attributes associated
with a given Instance will be shown in attribute
window 86. To edit attribute values, the user presses
the "Edit" button 70. Once all modifications have
20   been made, the user would preferably press an "Apply"
button 68 to record (i.e., incorporate) such changes.
The user presses the "Cancel" button 66 to abandon
changes. The user may remove an instance by pressing
"Delete" button 78. A designated "Refresh" button 80
25   is used to refresh, or update, the present screen so
that it displays current information.

Once a user has generated the required facility
modeling information, various facility modeling
processes, steps or functions (e.g., data
30   normalization, data aggregation, facility
benchmarking, report generation) may be activated
(operational). In accordance with certain present
embodiments, such functions may be activated when one
of these events occurs: (1) a user activates such

functions, (2) a user updates a facility model, or (3) a predetermined period of time elapses.

To help visualize and understand a Facility Model in accordance with the subject invention, Figure 4 represents a sample or exemplary Facility Model Architecture 96. Sample Facility Model Architecture 96 shows a global attribute catalog 98 which is used to create two model templates: (1) Model Template A 100, and (2) Model Template B 102. In this example, Model Template A has three attributes while Model Template B has only two attributes. Three Model A instances 104 and two Model B instances 106 are represented.

For Model A Instance X, shown in Figure 4, the facility area is 100,000 square feet, the number of employees is 50, and the number of outside doors is 15. For Model A Instance X+1, the facility area is still 100,000 square feet, but the number of employees has increased to 52, while the number of outside doors is still 15. Please note that updating the number of employees in this example marks the ending of Instance X and the beginning of Instance X+1.

When a facility Instance ends, as described above, the data normalization, aggregation, and benchmarking processes, steps or functions in accordance with the subject invention may be activated by a user as desired. For example, when a user is only interested in normalized data for one facility, the normalization process may be activated next. If, however, a user is interested in normalized data for a group of facilities, the aggregation process may be next activated in accordance with exemplary embodiments of the subject invention.

Whenever the normalization process is activated, it entails the process, in this example, of dividing a load profile channel, such as kiloWatt-hours (kWh), by a facility attribute, such as number (#) of employees, to obtain a new data set such as "kWh/employee". With reference to Model A Instance X (104), shown in Figure 4, described above, assume that the resource utilization data of interest is the amount of electricity consumed during Instance X and that such value (in this example) is 500 kWh. Noting from Figure 4 that the number of employees for Instance X is fifty, the subject exemplary normalization process would divide 500 kWh by 50 employees to give the normalized data of 10 kWh/employee.

Now consider as an example Model A Instance X+1 (Figure 4). Noting that the number of employees has changed to fifty-two, and again assuming that (for such Instance X+1) the electricity consumed is 500kWh, the normalized data for Instance X+1 is (as rounded) 9.6 kWh/employee (i.e., 500/52). Such normalized data for example could show the facility manager that adding two employees has not increased electrical energy cost for the facility. In fact, the electrical energy cost per employee is shown to have decreased slightly (based on the totally hypothetical, exemplary data indicated).

To generate aggregate normalized resource utilization data in accordance with the subject invention, an aggregation process is involved. Aggregate normalized resource utilization data is required when a user desires normalized data for a group of facilities. For example, with reference to present exemplary Figure 5, "List of Instances for an Aggregated Facility" 108, three facilities are being

compared. For this example, assume that the attribute
being tracked is the number of employees. There are
three so-called "Sub Facilities" in this example: Sub
Facility 1, Sub Facility 2, and Sub Facility 3. Five

5   instances 110 are shown for Sub Facility 1, two
instances 112 for Sub Facility 2, and three instances
114 for Sub Facility 3. In Figure 5, the first
Instance, X, 120, is defined as the first time a sub
facility model is updated to reflect changes in a

10   facility attribute. The second Instance, X+1, 122,
begins at the moment Instance X ends. Stated another
way, the end of Instance X is the beginning of
Instance X+1 and the end of X+1 is marked by the
beginning of Instance X+2, and so forth for n

15   subsequent Instances, X+n.

      Once an Instance is defined, an aggregation
process, step or feature in accordance with this
invention can sum the attribute values of interest for
all sub facilities. For Instance X (Figure 5), such

20   aggregation process in this example would add ten,
thirty-two, and twenty for a total 116 of sixty-two
employees. The next step in such preferred
aggregation process would be to sum the facility
resource utilization data of interest - kWh in this

25   example. Assuming that the energy consumption during
Instance X (Figure 5) is as follows: (1) Sub Facility
1, 500kWh, (2) Sub Facility 2, 875kWh, and (3) Sub
Facility 3, 600kWh, the aggregation process would add
the energy consumption data for such three sub

30   facilities to determine a total of 1,975 kWh (not
shown). The normalization step or function would
preferably then be activated, so as to divide the
aggregate resource utilization data by the aggregate
facility attribute data, and return an aggregate

normalized value (rounded) of 31.85 (1,975/62) kWh/employee.

Figure 6 represents a sample (or exemplary) organization 124 showing seven facilities owned by one user. Four exemplary facilities are located in an indicated territory, such as the Northeast 126 of the United States while three are located in the Southeast 128. Each exemplary facility (such as a store) has a Level-1 manager 129 while each group of stores, (Northeast, Southeast), share a respective Level-2 manager 130. Each of such Level-2 (or group) managers report to a Level-3 manager 132. While a Level-1 manager may only be interested in the normalized data for his or her facility, the Level-3 manager may wish to review the normalized data for all seven facilities individually, the aggregate normalized data for the four Northeast facilities, the aggregate normalized data for the three Southeast facilities, and/or the aggregate normalized data for all seven facilities, or some other statistical analysis.

Once the normalized or aggregate normalized resource utilization data has been created, a benchmarking process, step or feature in accordance with the present invention may be selectively activated. Such benchmarking, for example, may compare normalized data for two or more facilities, as specified by a user, and rank (i.e., benchmark) each facility based on said comparisons.

Importantly, as Level-1 managers (see Figure 6) update the facility models for their respective facilities, Instances are created (as described above), new normalized facility resource utilization data may be calculated, and new benchmarking data may be generated at all management levels. Consequently,

the present invention gives facility managers, whether responsible for one facility or numerous facilities, instantaneous facility resource utilization data and a powerful tool for monitoring and thus potentially controlling/reducing resource utilization.

In further present exemplary embodiments, a report generation process or feature may be selectively activated. Such report generation step or function may be used to present normalized data, aggregate normalized data, benchmarking results, and/or facilities models, all per user defined formats.

While flow charts per se have not been illustrated, the discussion above with reference to specific and general examples has been provided in such manner as to enable those of ordinary skill in the art to understand and use the invention. Specifically, exemplary methodologies and apparatuses/devices in accordance with the present invention may be practiced, such as with computer hardware and software installations. In such instances, those of ordinary skill in the art will readily ascertain the parameters of such particular embodiments based on the complete description within the subject application.

In addition, the present invention as described herein is not intended as being limited simply by virtue of specific exemplary language. For example, different "button" names may be utilized, without substantive impact on the invention disclosure herewith. For example, "Apply" could instead be relabeled as "Enter" or some other practical and/or understood convention. All such aspects of the present invention may be varied by those of ordinary

skill in the art during the course of implementing specific embodiments of this invention, without departing from the spirit and scope thereof.

5   While the invention has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily conceive of alterations to, variations of and equivalents to these embodiments. Accordingly, the

10   scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.